Pacific Flyway Center - Garibaldi Club #403
Individual Ownership Adaptive
Habitat Management Plan

(Revised: August 2021)

Suisun Resource Conservation District

2544 Grizzly Island Road
Suisun City, CA, 94585-9539
707-425-9302
srcd@suisunrcd.org

Table of Contents

Supporting Documentation and Scientific Information

A. Executive Summary

- The Suisun Marsh Protection Plan (SMPP), developed by the San Francisco Bay Conservation and Development Commission (BCDC) and the Department of Fish and Game (DFW) in 1976, was formally adopted as part of the Suisun Marsh Preservation Act of 1977 (SMPA 1977, Public Resources Code Section 29412.5). The SMPA 1977 required the Suisun Resource Conservation District (SRCD) to administer a Local Protection Program (LPP; SRCD 1980) including a water management program for each of the privately managed wetlands in the Suisun Marsh primary management area.

- The goal of the Individual Ownership Adaptive Habitat Management Plan (Plan) is to provide a managed wetland landowner with an overview describing existing conditions, operations, and guidance to support a diversity of waterfowl and wildlife habitats. The Plan includes a conservation map, soils map, elevation model, summary of water control structures, analysis of the water management program, and evaluation of the current conditions of levees, ditches, and water control structures.

- If wetland management is being implemented based on a certified Plan, landowners do not need a BCDC Marsh Development Permit (MDP) for routine maintenance of existing managed wetlands and water management facilities. Once the Plans are updated, annually, SRCD will make a report to BCDC's Executive Director of any minor amendments to any certified individual management plans (PRC Section 29418).

- Minor repairs or improvements are defined as those activities which are routine in management of wetland systems. Such activities as reconstruction, replacement, removal, repairs, and incidental additions are considered minor. Any management activity currently described in the certified Plan and its appendices will be considered minor and shall not require a BCDC MDP or an amendment to the certified Plan.

- This Plan is for Pacific Flyway Center - Garibaldi (SRCD Ownership #403). This club is located in the Northwest Region with typically higher salinity conditions for habitat management.

- The ownership consists of 559 acres: 315 acres of managed wetlands, 242 acres of uplands, and 2 acres of headquarters. The wetland is managed as 5 units with 5 intakes on Cordelia Slough and a dredger cut to the north of the property. The club drains into Cordelia Slough.

- The average elevation of Club #403 is 5.89 feet (NAVD88) including the upland and headquarters acres.

- Based on on-site observations, this club does not require the use of a pump to complete a flood and drain cycle to one foot below pond bottom within thirty days.

- Wetland habitat managers must adaptively manage their properties to achieve desired management objectives and habitat conditions. The Plan will serve as the starting point for development of long-term and short-term management goals for each ownership. It is a baseline from which to develop yearly plans tailored to each wetland ownership.

A.1. Goals

The purpose of this Individual Ownership Adaptive Habitat Management Plan (Plan) is to provide the basic information necessary for land managers in the Suisun Marsh (the Marsh) to successfully implement Marsh management practices. The goals are to maximize waterfowl food production while maintaining a diverse wetland flora that can support a wide variety of resident and migratory wildlife.

Section 29412.5 of the Public Resources Code established under the 1977 Suisun Marsh Preservation Act requires that the Suisun Resource Conservation District (SRCD) Local Protection Program (Suisun Marsh Management Program 1980) includes a water management program for each managed wetland in the primary management area of the Marsh. The Plan provides a wetland management guidance to support a diversity of waterfowl and wildlife habitats. The Plan includes a conservation map, soils map, elevation model, summary of water control structures, analysis of the water management program, and evaluation of the condition of levees and ditches. If wetland management is being implemented based on a certified Plan, landowners do not need a San Francisco Bay Conservation and Development Commission (BCDC) Marsh Development Permit (MDP) for routine maintenance of existing managed wetlands or maintenance of existing water management facilities. However, new managed wetland water management facilities such as exterior drain pipes, rip rap, bulkhead walls, or pump platforms, or an activity that meets the BCDC definition of "development" (**see Appendix A.2**) will require a BCDC MDP. If new construction, replacement, or improvements are needed on the clubhouse area, building structures, or boat docks, the landowner should consult with Solano County Department of Resource Management (DRM) and BCDC for permitting requirements.

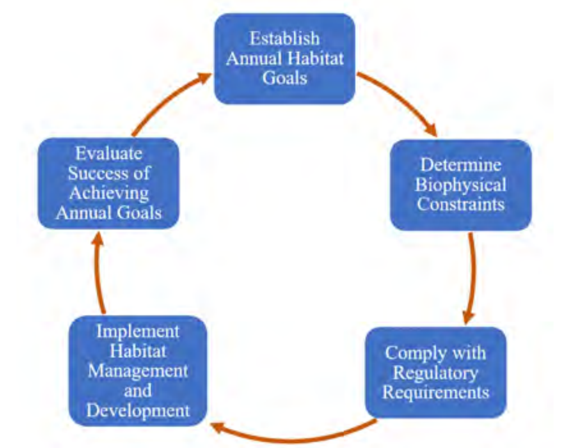


Figure 1. Annual habitat management flowchart.

The physical, regulatory, and biological conditions in the Marsh affect wetland management strategies which determine the resulting habitat quality, and ultimately the species that will use the habitat. Wetland habitat managers must adaptively manage their properties in order to achieve desired management objectives and habitat conditions **(Figure 1)**. Since conditions in the Marsh continually change, we have developed the attached Supporting Documentation and Scientific Information so as new information is obtained or changes in management strategies are identified, they can be incorporated into the Plan attachments. Minor modification of a certified Plan (such as replacing a cast iron flap gate with stainless steel) will be submitted by the landowner to SRCD annually and SRCD will record the change as a minor revision to the Plan. Minor repairs or improvements are defined as those activities which are routine in management of wetland systems. Such activities as reconstruction, replacement, removal, repairs, and incidental additions should be considered minor. Any management activity currently described in the certified Plan and its appendices will be considered minor and shall not require a BCDC MDP or an amendment to the certified Plan. SRCD will process the modifications annually in accordance with the provisions of Section 29418 of the Public Resource Code (Suisun Marsh Management Program 1980).

B. Club Information

The Pacific Flyway Center - Garibaldi (SRCD Ownership #403) is located on the westside of Suisun Marsh. Access to the property is off Interstate 680, exiting Gold Hills Road, taking a right on Ramsey Road, and following it to the dead end approximately 1 mile (**Figure 2**). This property was recently purchased in a land swap with California Department of Fish and Wildlife. The original management plan for the Garibaldi Brothers Club (SRCD Ownership #403) was certified by BCDC on Nov. 15, 1984.

Figure 2. Property location in Google Earth.

Table 1. Land use description and estimated acreage

Land Description	Acres
Managed Wetland	315
Uplands	242
Headquarters	2
Total	559

B.1 Club Facilities

There is one storage structure and five managed wetland units **(See "H" on Map 1**). If improvements are needed for a clubhouse area or building structures, the owner should consult with Solano County DRM and BCDC for permitting requirements.

B.2 Hydrology and Infrastructure

B.2.1 Water Circulation

Club #403 is bordered by the Interstate 680 on the western side, and a single levee around the exterior of the club. Four small interior levees surround a small brood pond and separates the property into five wetland units. The club brings in water from Cordelia Slough all along the exterior levee. The water flows through a ditch system that heads south and southeast in some ponds, and north to northeast in another. The club is also supplied by drainage storm water runoff events from the adjacent hills to the west and control it with interior water controls. Water flows towards the east side of the property where it drains into Cordelia Slough.

B.2.2 Infrastructure

Unit 1: Northwest Pond

Flooding of this managed pond is accomplished through water control structure (Gate **A**) on the northern end of the pond. Structure **A** has both flood and drain capacity. Water can either circulate and drain through Gate **A** or it can flow southeast to an interior drain structure (gate **e**) that circulates water into the Center Pond toward the main drain structure (Gate **D**).

Unit 2: Center Pond

Flooding of this managed pond is accomplished through water control structure (Gate **B**) on the northern end of the pond. Structure **B** has both flood and drain capacity. Water can either circulate and drain through Gate **B** or it can flow southeast to an interior drain structure (gate **d**) that circulates water into the Eastern Pond toward the main drain structure (Gate **D**).

Unit 3: Eastern Pond

Flooding of this managed pond is accomplished through water control structure (Gate **C**) on the northern end of the pond. Structure **C** has both flood and drain capacity. Water can either circulate and drain through Gate **C** or it can flow south toward the main drain structure (Gate **D**).

Unit 4: Western Pond

Flooding of this shared managed pond is accomplished by capturing storm water runoff from the adjacent development or hills. Interior water controls (Gates **a** and **c**) can hold back or allow freshwater runoff to be held in the western pond or circulate and flow into the southwest pond towards the main drain structures (Gates **E** and **F**).

Unit 5: Southwest Pond

Flooding of this managed pond is accomplished through two water control structures (Gate **E** and **F**) on the southeast end of the pond. Structures **E** and **F** both have flood and drain capacity. Water can either circulate and drain back through Gates **E** and **F** or it can flow north to an interior drain structure (gate **b**) that circulates water into toward the main drain structure (Gate **D**) in the eastern pond.

Water movement through the club is facilitated by a system of perimeter and interior ditches which partition the club into five pond areas. Secondary ditches connected to primary ditches move water from ponds to water control structures to facilitate water flow and drainage. Circulation is achieved across the ponds in a north and west direction (**Map 2)**. See the Water Management Infrastructure Table for details and locations (**Table 2**).

Table 2. Water management infrastructure including Identification Number (ID), Pond Unit (Unit), Flow Direction (Flow), XY coordinates: WGS84 Longitude (Lon), Latitude (Lat), Pipe Material (Pipe), Year pipe installed (Year), Diameter (Dia), Length (Len), Gate Type/Gate Material (Gate), Year gate installed (Year), Invert Elevation (Elev): NAVD88, Exterior (Ext), Interior (Int)

ID	Unit	Flow	Lon	Lat	Pipe	Year	Pipe		Interior		Exterior		Invert Elev (ft)		Comments
							Dia (in)	Len (ft)	Gate	Year	Gate	Year	Ext	Int	
Exterior water control structures															
A	1	FD	-122.127158	38.178626	HDPE	2019	36	50	SF/SS	2019	SF/SS	2019	--	--	
B	2	FD	-122.121766	38.178593	HDPE	2014	24	50	SF	2014	SF	2014	--	--	
C	3	FD	-122.119314	38.178600	HDPE	--	36	50	SF	--	SF	--	--	--	
D	3	D	-122.114323	38.171045	HDPE	--	36	50	FBR	--	FG	--	--	--	
E	5	FD	-122.109129	38.162409	HDPE	--	36	50	FBR	2019	SF	2019	--	--	
F	5	FD	-122.114812	38.161245	HDPE	--	36	50	SF	2019	SF	2019	--	--	
Interior water control structures															
a	4	D	-122.118492	38.164253	CPP	-	18	30	FBR	--	O	--	--	--	
b	5	D	-122.114709	38.170982	HDPE	2019	18	30	FBR	--	O	--	--	--	
c	4	D	-122.118451	38.168950	CPP		24	30	FBR	-	O	-	-	-	Non-Operable (Plugged)
d	2	D	-122.118766	38.174279	CPP		18	30	FBR	--	O	-	-	-	
e	1	D	-122.122938	38.176155	CPP		18	30	FBR	--	O	-	-	-	

Flow: Flood (F), Drain (D), Flood and Drain (FD), Pipe: Concrete (C), Corrugated Metal Pipe (CMP), Corrugated Plastic Pipe (CPP), Fiberglass (FB), Fiberglass and Metal (FBM), High Density Polyethylene Pipe (HDPE), Plastic (PP), Gate Type: Flap (FG), Flash Board Riser (FBR), Open (O), Screw (SG), Screw Flap (SF),Weir (W), Winch Flap (WF), Gate Material: Stainless Steel (SS), Cast Iron: (CI)

B.2.3 Digital Elevation Model (DEM)

In 2018, an airborne Light Detection And Ranging (LiDAR) survey was completed to collect elevation data across the Marsh. However, dense vegetation may obscure the ability to measure the bare earth elevation. In this LiDAR-derived elevation map, we corrected for vegetation height to obtain the wetland pond bottom elevation (Buffington et al. 2016). We used multispectral airborne imagery and field surveys to improve elevation accuracy from 40% to 75% in a high-resolution image (1-m pixels). We have provided a map from the LiDAR data for Club #403 along with associated hardwater mark elevation data indicating shoot level collected as part of the Managed Wetland Assessment (MWA: Chappell et al. 2018) project during that same year (**Map 3**).

Elevations were measured using the North American Vertical Datum of 1988 (NAVD88). A vertical datum is used as a reference system to measure and relate elevations to the earth's surface and NAVD88 is the official vertical datum for the contiguous United States (U.S.). In 2018, the average pond bottom elevation (NAVD88, ft) measured for Unit 1 was 6.33, for Unit 2 was 3.14, for Unit 3 was 1.68, and for Unit 5 was 2.25 compared to an overall average bare earth elevation of 2.41 feet (NAVD88) for the primary management area of the Marsh. The complete LiDAR coverage is available at the U.S. Geological Survey (USGS) Science Base website (Buffington et al. 2019).

B.2.4 Target Water Levels

A goal of managed wetlands is to complete a flood and drain cycle (leach cycle) within 30 days to reduce and maintain lower soil salt concentrations **(Section B.5.1)**. Applied water salinity from adjacent channels is an important consideration for management since it affects the ability of the managed wetlands to produce vegetation and create habitat conditions necessary to support waterfowl food crop production **(Section C.2.1.4)**. To complete a leach cycle, the pond should be drained until the water in the ditches is 1 foot below the pond bottom (Rollins 1981), typically, 2 feet below shoot level.

Based on on-site observations, the club is able to complete a spring leach cycle within thirty days without the use of a pump **(Figure 3)**. Since tidal datums are commonly used as references to measure local water levels, see **Appendix K** for the local tidal values relative to NAVD88 elevation values.

B.2.5 Shared Water Levels/Shared Infrastructure

Club #403 does not share a water level or water control structures with other clubs, but maintenance of interior levees is critical for effective water management and meeting the club's habitat objectives.

B.2.6 Soil Information

In 1978, the Soil Conservation Service surveyed the soil and provided a detailed summary map with soil descriptions for the managed wetland properties in the Marsh. The intention of the survey was to be used as a guide for wetland managers on vegetation, irrigation, and management. A current soil map was obtained from the Web Soil Survey (WSS) website. The WSS is operated by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and is updated and maintained as the single authoritative source of soil survey information. The primary soils on this property include Alviso silty clay loam (14.4%), Clear Lake clay (5.0%), Dibble-Los Osos clay loams (0.8%), Reyes silty clay (40.5%), Rincon clay loam (7.1%), Sycamore silty clay loam (15.8%), and Tamba mucky clay (12.7%) (**Map 4**). See **Appendix L** for more detailed information about Suisun Marsh soils.

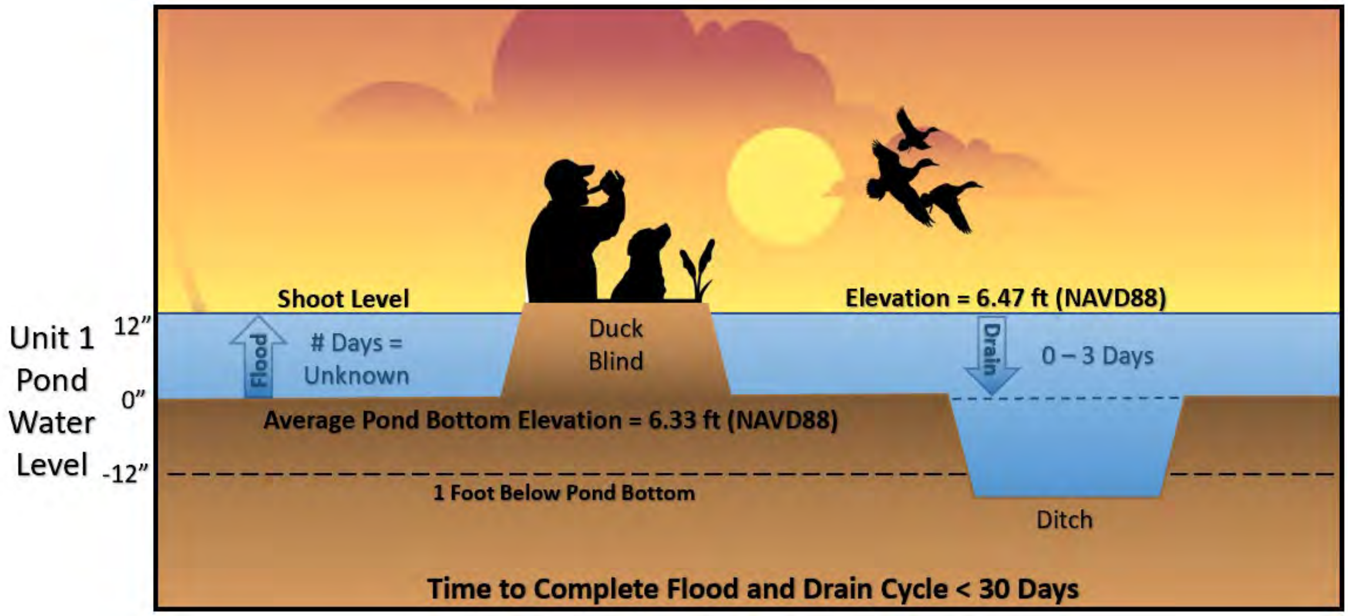


Figure 3a. RMA drainage model results suggest that it will take Unit 1 zero to three days to drain to one foot below shoot level. Based on on-site observations, Unit 1 is able to complete a spring leach cycle within thirty days without the use of a pump.

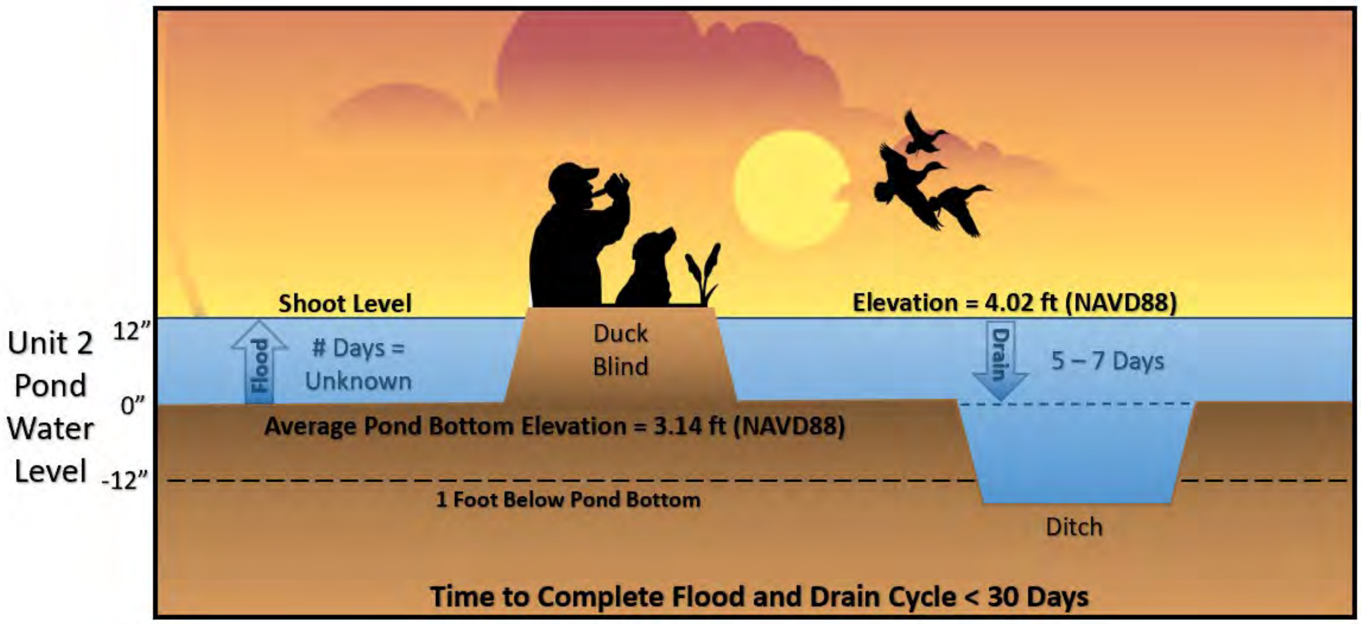


Figure 3b. RMA drainage model results suggest that it will take Unit 2 five to seven days to drain to one foot below shoot level. Based on on-site observations, Unit 2 is able to complete a spring leach cycle within thirty days without the use of a pump.

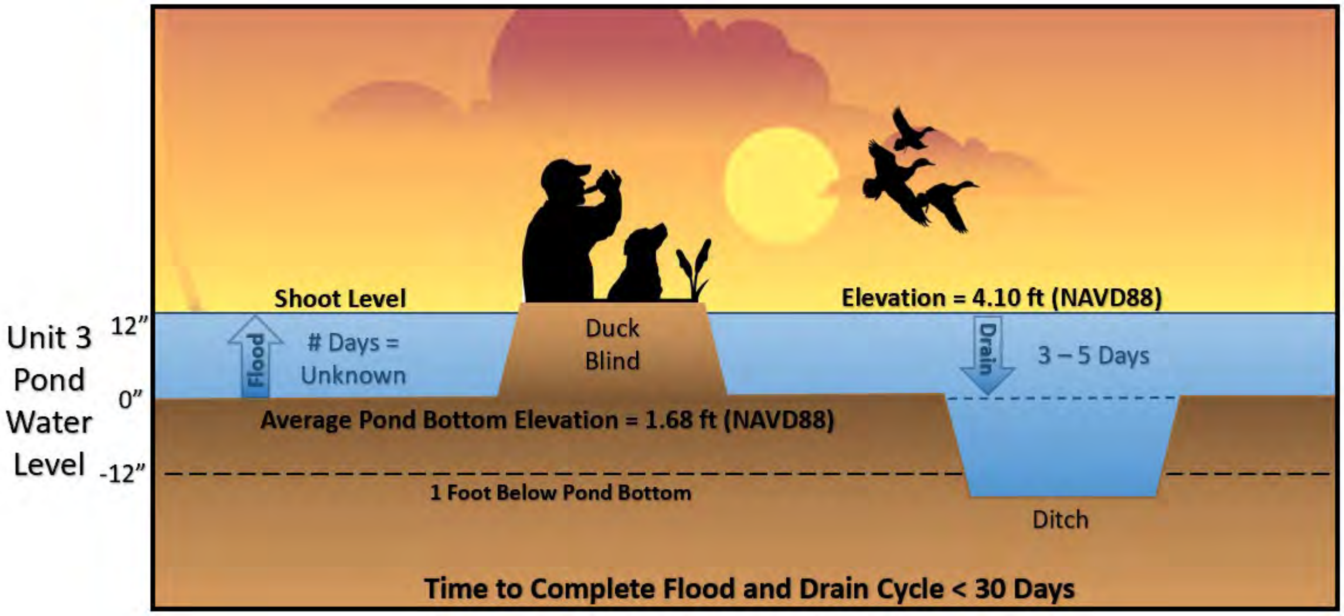


Figure 3c. RMA drainage model results suggest that it will take Unit 3 three to five days to drain to one foot below shoot level. Based on on-site observations, Unit 3 is able to complete a spring leach cycle within thirty days without the use of a pump.

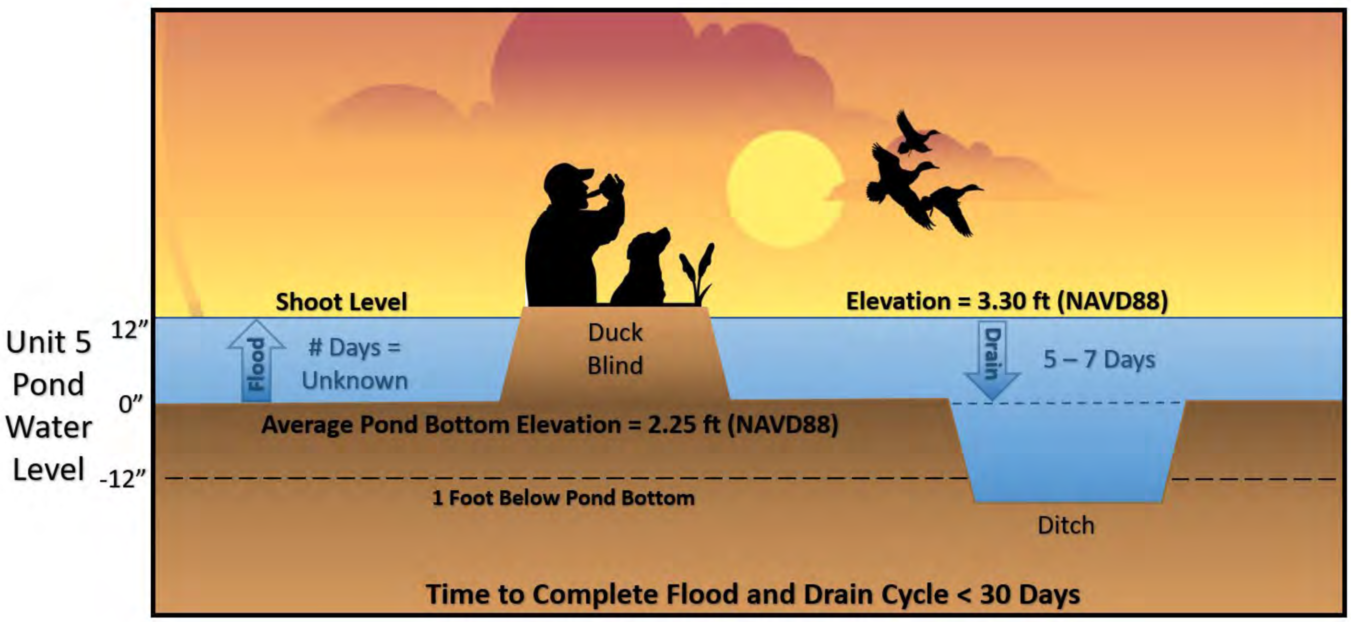
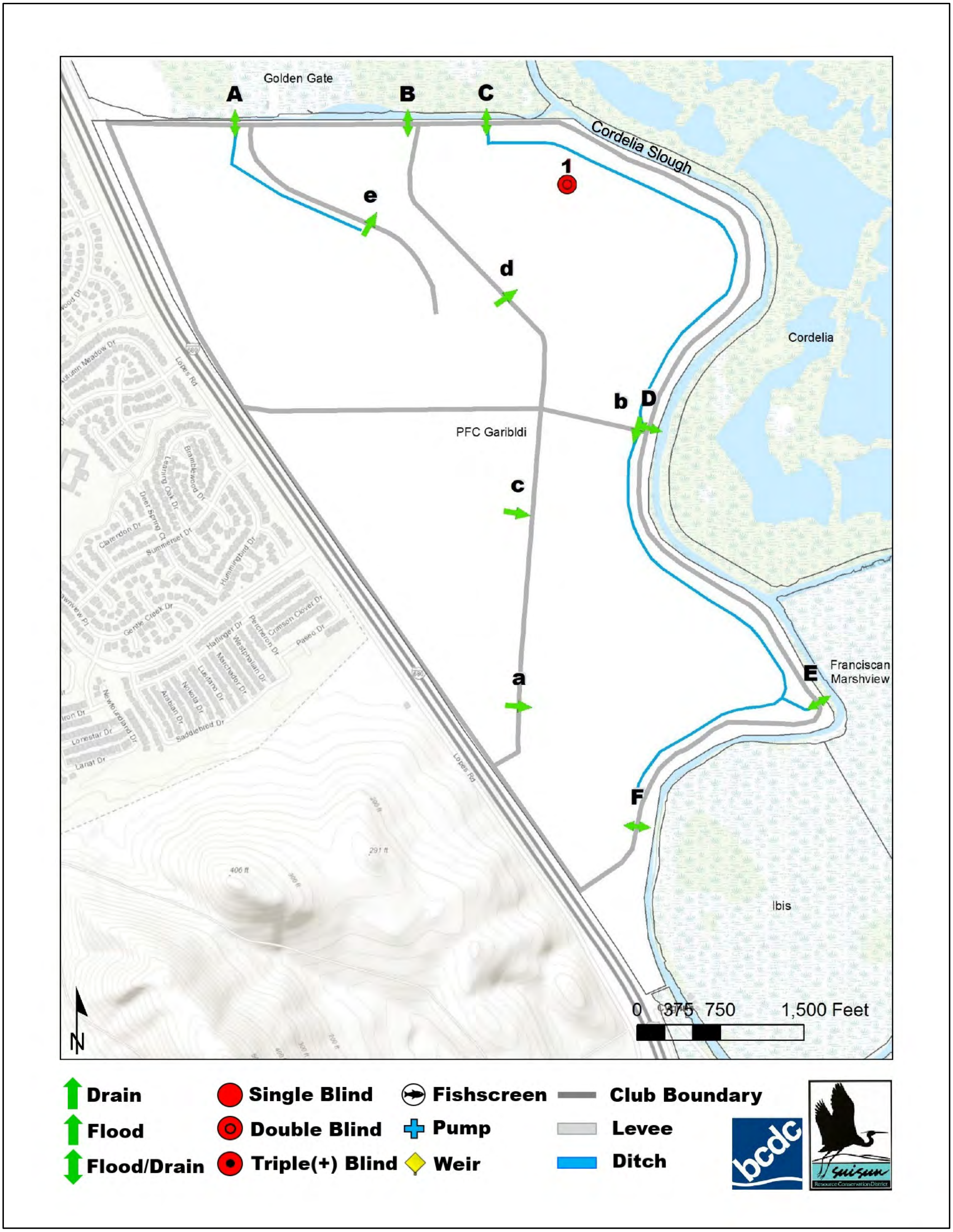
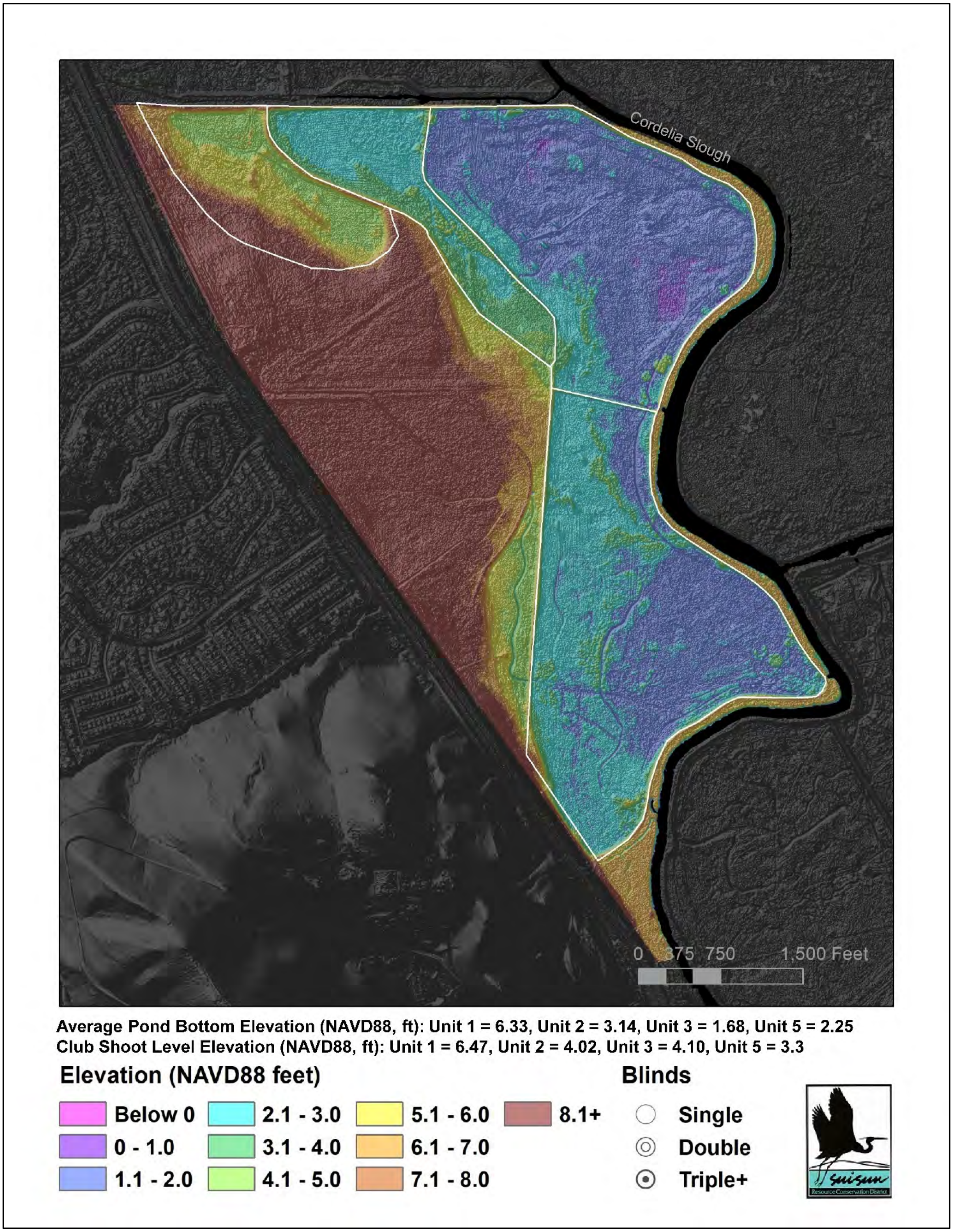


Figure 3d. RMA drainage model results suggest that it will take Unit 5 five to seven days to drain to one foot below shoot level. Based on on-site observations, Unit 5 is able to complete a spring leach cycle within thirty days without the use of a pump.

Map 1. Club #403 aerial imagery. Source: USDA National Agriculture Imagery Program (NAIP) 2018.



Map 2. Club #403 water control infrastructure. Source: Geomarsh (SRCD and BCDC, 2020).



Map 3. In 2018, the average pond bottom elevation (NAVD88, ft) measured for Unit 1 was 6.33, for Unit 2 was 3.14, for Unit 3 was 1.68, and for Unit 5 was 2.25 compared to an overall average bare earth elevation of 2.41 feet (NAVD88) for the Marsh primary management area. Sources: Buffington et al. 2019 and Chappell et al. 2018.

Map 4. The primary soils on Club #403 include Alviso silty clay loam (14.4%), Clear Lake clay (5.0%), Dibble-Los Osos clay loams (0.8%), Reyes silty clay (40.5%), Rincon clay loam (7.1%), Sycamore silty clay loam (15.8%), and Tamba mucky clay (12.7%). Source: Natural Resources Conservation Service Web Soil Survey, Version 14, May 29, 2020

Map 5. Club #403 Conservation Plan Map of 1978. Source: USDA Soil Conservation Service.

B.3 Needs for Maintenance

Since levees, ditches, and water control structures are crucial for proper water management **(Section C.2.1.1)**, they should be inspected and maintained in functional order **(Appendix I)**. Water control structures should be kept free of debris, be maintained to prevent leaks, and lubricated to ensure free-moving parts. Presently, all structures on Club #403 are operational and in good condition.

Levees in the Marsh are comprised of silts, clay, and organic materials that are subject to shrinkage and subsidence as well as tidal erosion and animal damage; therefore, they require periodic re-topping and other maintenance. The protective tule berms present along the exterior levees are helpful in guarding the exterior levee against tidal erosion. However, the exterior levee is especially susceptible to storm driven waves and high tides and should be carefully observed for potential weak spots and storm damages. Club #403 has an adequate system of primary and secondary ditches which is important for circulation and drainage. Excessive vegetation or siltation should be removed from these ditches as necessary to promote maximum waterflows.

B.4 Reclamation Districts (RD)

Club #403 does not belong to a Reclamation District.

B.5 Water Management Program for Targeted Habitats

In light of the rapidly changing environmental conditions including climate change, a prescriptive water management plan (as originally developed in the 1980s) for each club is not being recommended in this Plan update. Instead, landowners are provided with a range of water management options that can vary from year to year based on environmental, regulatory and maintenance needs and targeted habitat objectives. Conceptual models for water management (**Figures 4 & 5**) have been developed in partnership with DFW (Barthman Thompson et al. 2007) to provide the best managed wetland habitats in the Marsh. SRCD has identified regions in the Marsh where conditions are most suitable for particular water management scenarios. The following water management information is specific for the managed wetlands covered under this Plan **(Appendix N)**.

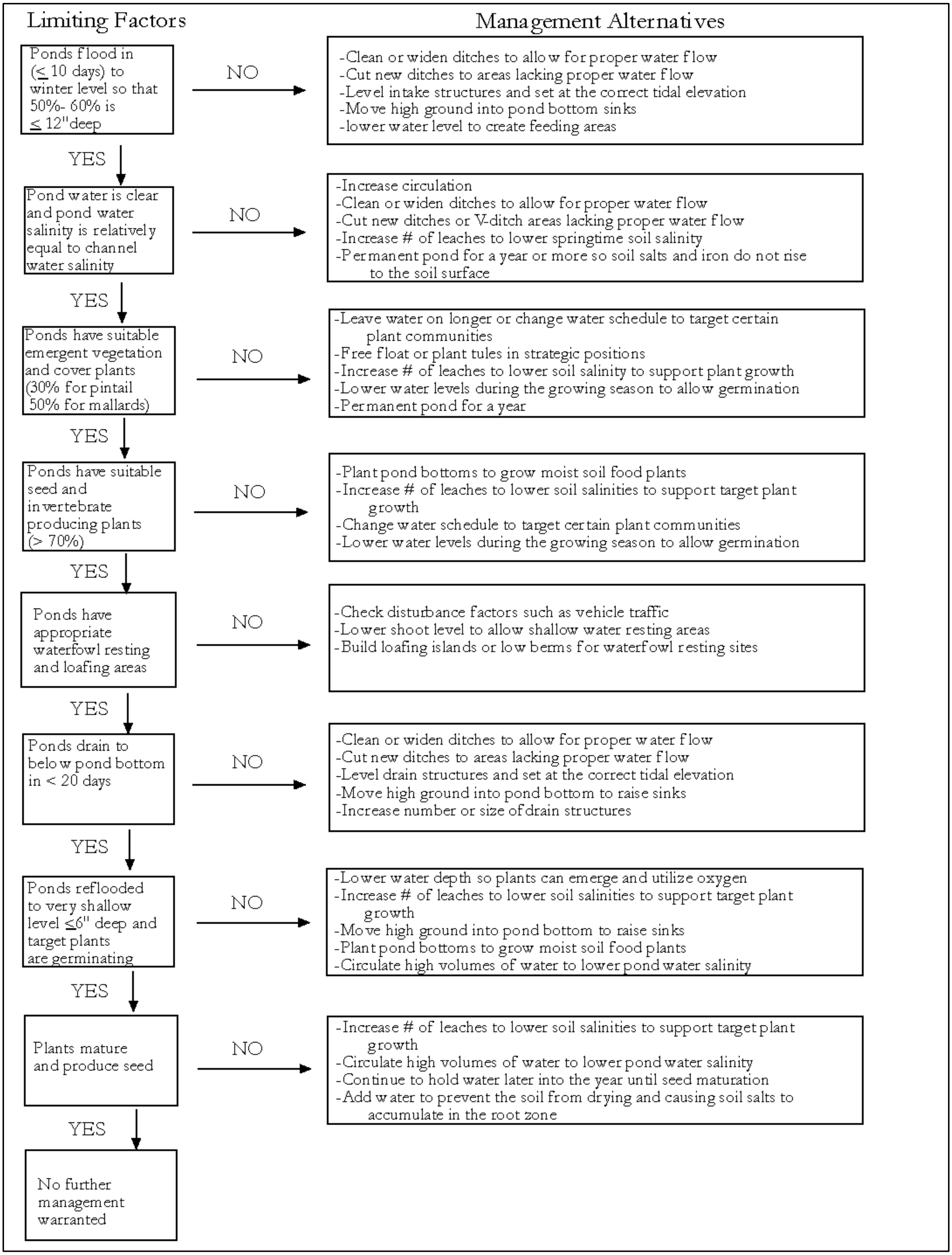


Figure 4. Example of a waterfowl pond management flowchart for typical wintering waterfowl (Barthman Thompson et al. 2007).

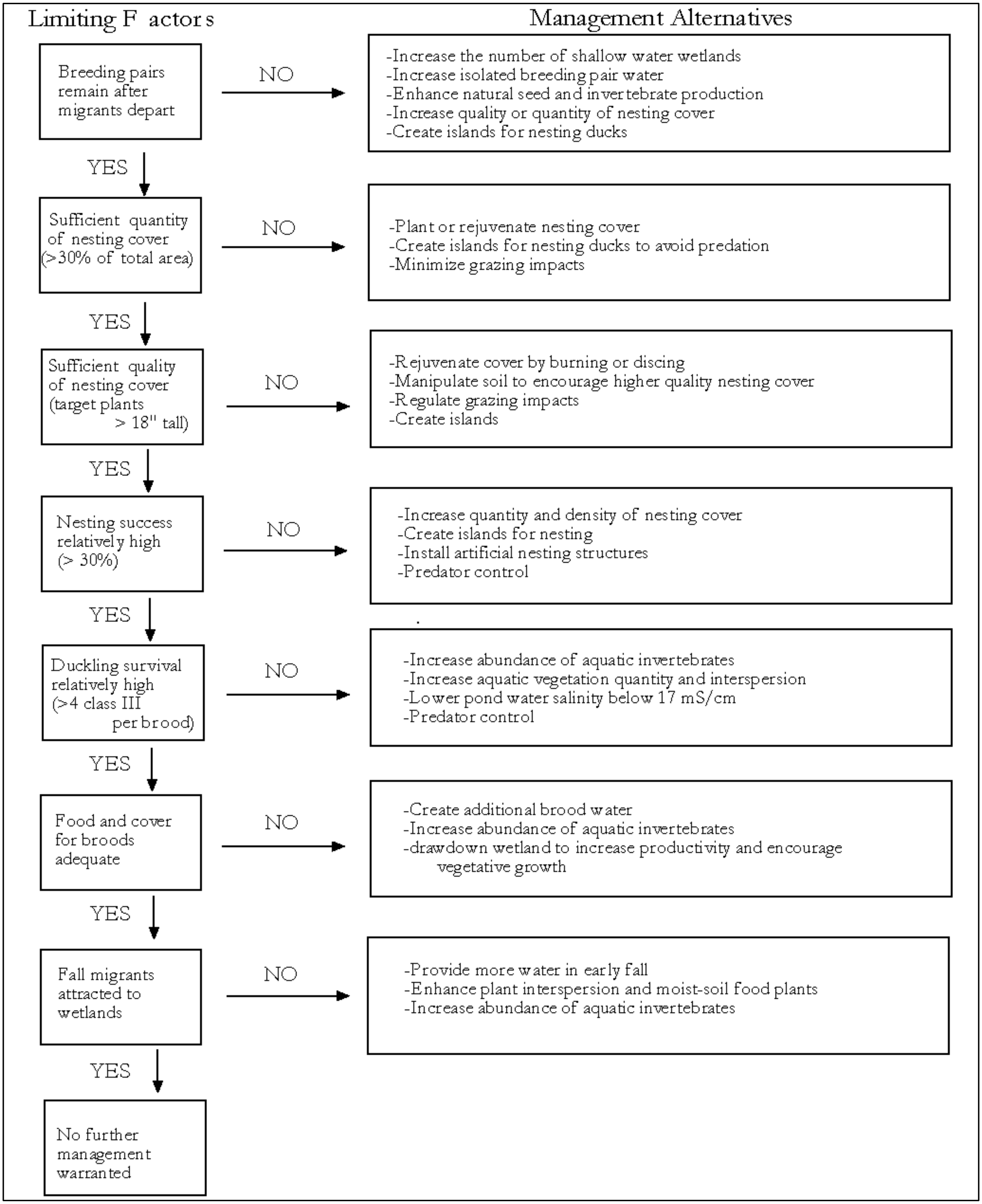


Figure 5. Example of a waterfowl pond management flowchart for typical breeding waterfowl (Barthman Thompson et al. 2007).

B.5.1 General Management Considerations

A goal for managed wetlands is to be able to complete a flood and drain cycle within 30 days to reduce soil salt concentrations and produce a diversity of wintering waterfowl food crops in the Marsh **(Section C.2.1.2)**. To meet this 30-day objective, a pump is needed on many clubs to assist with drainage on the managed wetlands. Drainage should begin about 20 days prior to the lowest tides of the month, to use of the tide gates effectively. Pump usage will depend upon varying yearly tide cycles **(Section C.2.1.3)** and how efficiently tidal flooding and drainage can be accomplished but should be used to remove water from pond bottom sinks and primary ditches 1' below pond bottom. Levees, ditches, and water control structures should be inspected annually and maintained in functional order. Excessive vegetation or siltation should be removed from ditches as necessary to promote optimal waterflows and leach cycles.

Ponds are fully flooded targeting 12 inches of water over a majority of the pond during waterfowl season (mid-October through late-January). In mid-January, managers close pond intakes and begin to drain ponds. Ponds will be reflooded to approximately 6 to 12 inches below shoot elevation and are drained completely around mid-March to early April to initiate the first leach cycle. Water circulation and performing leach cycles in managed wetlands is crucial to reduce salinity and low dissolved oxygen (DO) accumulation from ponds and encourage a diversity of vegetation growth through the spring and early summer (**Figure 6**).

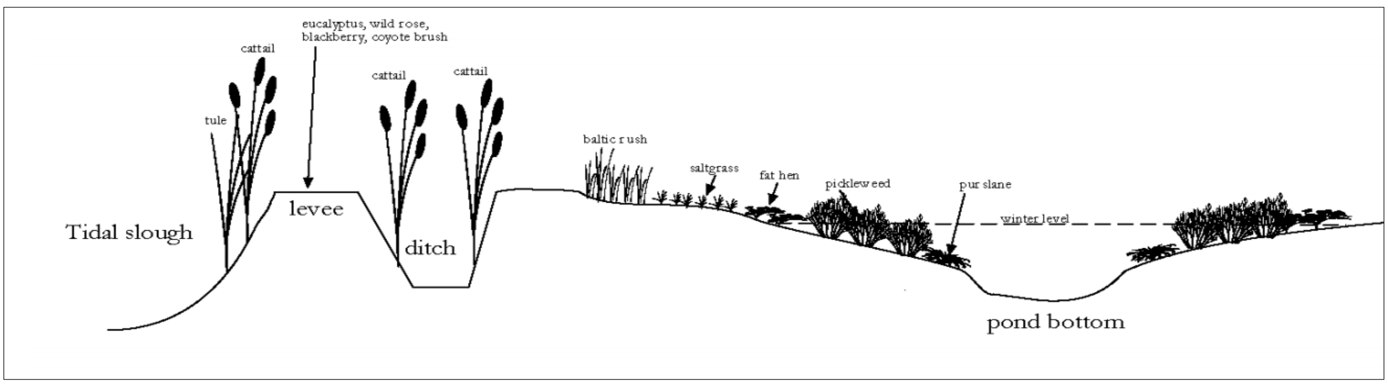


Figure 6. Schematic of typical long hydroperiod plants and elevation location (Barthman Thompson et al. 2007).

B.5.2 Water Management Guidelines

Water management is the primary means for habitat managers to manipulate managed wetland vegetation communities in the Marsh. SRCD developed eleven water management schedule guidelines to assist the wetland property owners and managers. The schedules are intended as guidelines because site specific factors will influence actual management decisions that will be made to reach the objectives for the property, and because management schedules will change for different regions in the Marsh and for different water years (**Appendix O**). Site-specific regulatory and physical conditions will influence actual management practices on individual properties. Below are two examples of these typical water management schedules **(Figures 7 & 8,** see **Appendix O** for other schedules**)**.

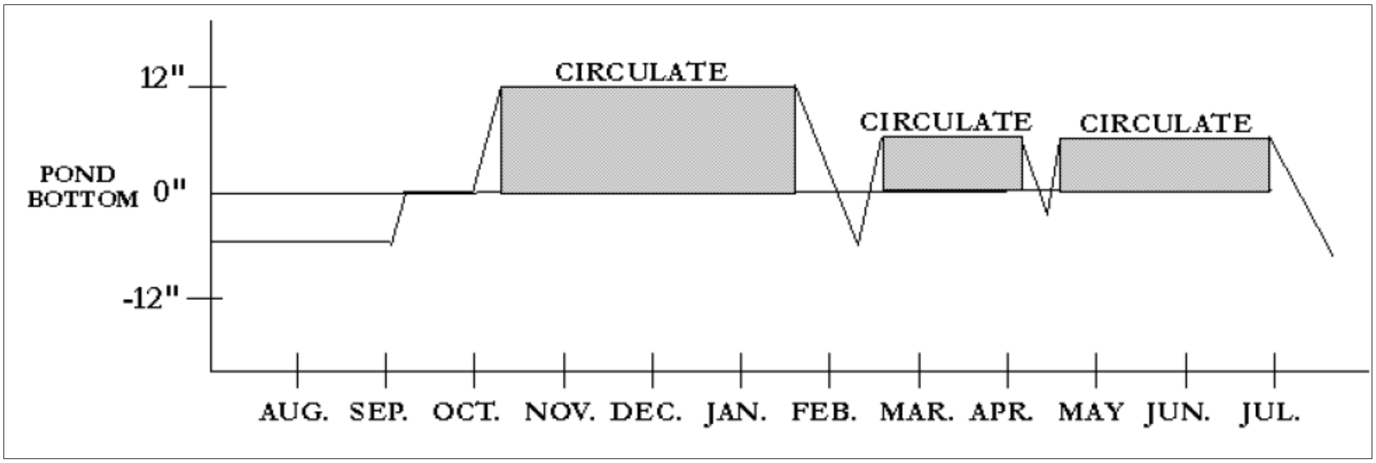


Figure 7. No Intake Restrictions / Normal Flood Date / Long Hydroperiod (Barthman Thompson et al. 2007).

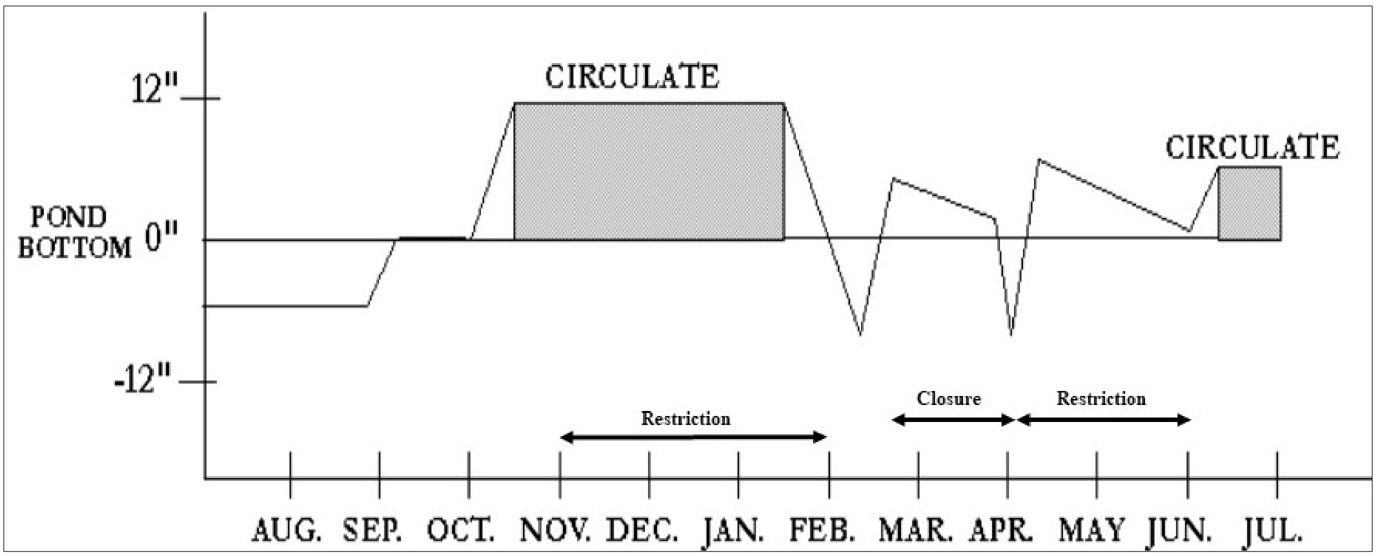


Figure 8. All potential intake restrictions/Long Hydroperiod (Barthman Thompson et al. 2007).

B.5.3 Regional Water Management

Club #403 does not rely on any regional joint use facilities for water management.

B.5.4 Regional Habitat Management Guidelines

The timing, duration, and depth of flooding is the most significant driver of marsh ecology (Mitsch and Gosselink 2000), since it influences vegetation composition, substrate character, and hydrologic connectivity. Factors that affect plant growth in the Marsh are short and long hydroperiods including frequent droughts, the east-west and north-south salinity gradients; length of soil submergence; soil salinity; water depth; salinity of applied water; competition from other plants, including nonnative invasives (DWR 2001 and SRCD 1998). Wetland managers use moist-soil management practices that encourages seed-producing plants by mimicking seasonal wet and dry cycles of natural wetlands and allows habitat management activities such as burning, mowing, and disking to be conducted annually during the summer dry cycle. Leaching cycles are conducted in the spring adding low salinity applied water to reduce soil salinities and improve plant germination and growth. Infrastructure including levees, ditches, water control structures, topography, pumps, and fish screens are used to meet management objectives. Biodiversity is retained through adaptive management and topographic variation creating microclimates with different communities present on the marsh plain, benches, and uplands. In addition, biophysical factors, such as soil chemistry or establishment of floating invasive plants in ponds and ditches, affecting different areas of the Marsh may influence the management for specific wetland habitats.

Northwest Marsh Region with Higher Salinity Conditions

Cordelia Slough, lower Suisun Slough, and the smaller associated slough channels such as Frank Horan, Wells, and Chadbourne Sloughs have extremely variable salinity levels throughout each year. In late summer and early fall, or during periods of drought and low rainfall, channel salinities in this region can be relatively high. But due to the proximity to the surrounding watershed and small creek systems (Green Valley Creek and Suisun Creek), during wet periods, a large influx of freshwater runoff can quickly lower channels water salinities.

The overall management targets of the clubs with the ability to draw down or drain after duck season allow removing higher salinity water that has been circulated during the waterfowl season. This exchanges 75-90% of the higher salinity water with lower salinity water in early February. Based on the water year and the tide cycles, the clubs may flood, circulate, and drain 2-4 times during the early spring. These leach cycles remove accumulated soil salts that aid in producing quality food habitat. In years with favorable conditions (periods of high precipitation and Delta outflow), these clubs can produce large quantities of Swamp Timothy, Brass Buttons, and Rabbitsfoot Grass. Smartweed and Watergrass are also possible with optimum conditions and good drainage capacity.

During years with higher salinity water (periods of low precipitation and low Delta outflow), the clubs limit their water management window to the early spring, so they do not irrigate with higher salinity water in the late spring and increase soil salinities. On those given years, the production of the management wetland may shift to Pickleweed, Fat Hen, Alkali Bulrush, and Sea Purslane habitats. The main benefit of reducing the accumulation of soil salinity is improved production of saline-sensitive plants such as Watergrass during fresher water years.